

CLAIMS

What is claimed is:

1. A method for recovery of liquefied petroleum gas or natural gas liquids from liquefied natural gas, the method comprising:
  - receiving an input stream comprising substantially rich liquefied natural gas;
  - splitting the input stream into a direct stream and a bypass stream;
  - heating said direct stream in a cross-exchanger to produce a stream of heated rich liquefied natural gas;
  - splitting said heated rich liquefied natural gas into a primary column feed and a secondary column feed;
  - vaporizing at least a major portion of said secondary column feed in a vaporizer to produce a vaporized secondary column feed;
  - fractionating a top feed, said primary column feed, and said vaporized secondary column feed in a fractionation unit to produce an overhead product stream and a bottom product stream;
  - condensing at least a major portion of said overhead product stream by cooling said overhead product stream in said cross-exchanger to produce a condensed overhead product stream;
  - pumping a reflux portion of said condensed overhead product stream to a top of said fractionation unit as said top feed;
  - mixing said bypass stream with a balance portion of said condensed overhead product stream to produce an output stream; and
  - vaporizing said output stream to produce a conditioned natural gas suitable for delivery to a pipeline or for commercial use.

2. The method of claim 1, comprising further:  
diverting a portion of said heated rich liquefied natural gas into an optional bypass stream; and  
mixing said optional bypass stream with said balance portion of said condensed overhead product stream to produce said output stream.
3. The method of claim 1, wherein said natural gas liquids comprise C<sub>2+</sub> hydrocarbons.
4. The method of claim 1, wherein said input stream is at a temperature in a range of -240°F to -260°F.
5. The method of claim 1, wherein said cross-exchanger heats said direct stream of said input stream to a temperature in a range of -115°F to -140°F.
6. The method of claim 1, wherein said vaporizer heats said secondary column feed to a temperature in a range of 30°F to 60°F.
7. The method of claim 1, wherein said cross-exchanger cools said overhead product stream to a temperature in a range of -120°F to -145°F.
8. The method of claim 1, wherein said reflux portion is comprised substantially of liquid.
9. The method of claim 1, wherein said primary column feed is comprised substantially of liquid.
10. The method of claim 1, wherein said vaporized secondary column feed is substantially pre-heated.
11. The method of claim 1, wherein said overhead product stream is comprised substantially of vapor.

12. The method of claim 1, wherein said bottom product stream is comprised substantially of natural gas liquids.

13. The method of claim 1, wherein said overhead product stream exits said fractionation unit at a temperature in a range of  $-80^{\circ}\text{F}$  to  $-130^{\circ}\text{F}$ .

14. The method of claim 1, wherein said bottom product stream exits said fractionation unit at a temperature in a range of  $50^{\circ}\text{F}$  to  $120^{\circ}\text{F}$ .

15. The method of claim 1, wherein said direct stream of said input stream is heated by absorbing heat from said overhead product stream.

16. The method of claim 1, wherein said overhead product stream is condensed by rejecting heat to said direct stream of said input stream.

17. An apparatus for recovery of liquefied petroleum gas or natural gas liquids from liquefied natural gas, comprising:

a fractionation unit for fractionating a top feed, a primary column feed, and a vaporized secondary column feed and producing an overhead product stream and a bottom product stream;

a diverter for splitting an input stream comprising substantially rich liquefied natural gas into a direct stream and a bypass stream;

a cross-exchanger receiving said direct stream and heating said direct stream to produce a stream of heated rich liquefied natural gas while condensing at least a major portion of said overhead product stream to produce a condensed overhead product stream;

a diverter for splitting said heated rich liquefied natural gas into said primary column feed, optional bypass stream and a secondary column feed;

a vaporizer for vaporizing at least a major portion of said secondary column feed and producing said vaporized secondary column feed;

a pump for pumping a reflux portion of said condensed overhead product stream to a top of said fractionation unit as said top feed;

a mixer for mixing a bypass portion of said rich liquefied natural gas and optional bypass stream with a balance portion of said overhead product stream to produce an output stream;

an output vaporizer for vaporizing said output stream to produce a conditioned natural gas suitable for delivery to a pipeline or for commercial use.

18. The apparatus of claim 17, wherein:

said diverter diverts a portion of said heated rich liquefied natural gas into an optional bypass stream; and

said mixer mixes said optional bypass stream with said balance portion of said overhead product stream to produce an output stream.

19. The apparatus of claim 17, wherein said fractionation unit is selected from the group consisting of:

a trayed column having approximately thirty trays,

a packed column, and

a combination of said packed and said trayed column.

20. The apparatus of claim 17, wherein said fractionation unit fractionates ethane, propane and heavier components from methane and lighter components in said top feed, said primary column feed, and said vaporized secondary column feed.

21. The apparatus of claim 17, comprising further a reboiler adding heat to a bottom re-boil stream from said fractionation unit and re-injecting said bottom re-boil stream into said fractionation unit.

22. The apparatus of claim 21, wherein said re-boiler comprises a submerged combustion vaporizer.

23. The apparatus of claim 17, wherein a heat source of said vaporizer is selected from the group consisting of:

sea-water,

cooling water for open rack vaporizers,

fuel gas for submerged combustion vaporizers, and

indirect heating fluid for indirect fluid vaporizers.

24. A system for recovery of liquefied petroleum gas or natural gas liquids from liquefied natural gas, comprising:

means for receiving an input stream comprising substantially rich liquefied natural gas;

means for splitting the input stream into a direct stream and a bypass stream;

means for heating a direct stream of said input stream to produce a stream of heated rich liquefied natural gas;

means for splitting said heated rich liquefied natural gas into a primary column feed and a secondary column feed;

means for vaporizing at least a major portion of said secondary column feed to produce a vaporized secondary column feed;

means for fractionating a top feed, said primary column feed, and said vaporized secondary column feed to produce an overhead product stream and a bottom product stream;

means for condensing at least a major portion of said overhead product stream to produce a condensed overhead product stream;

means for pumping a reflux portion of said condensed overhead product stream to a top of said fractionation unit as said top feed;

means for mixing a bypass portion of said rich liquefied natural gas with a balance portion of said condensed overhead product stream to produce an output stream;

means for vaporizing said output stream to produce a conditioned natural gas suitable for delivery to a pipeline or for commercial use.

25. The system of claim 24, comprising further:

means for diverting a portion of said heated rich liquefied natural gas into an optional bypass stream; and

means for mixing said optional bypass stream with said balance portion of said condensed overhead product stream to produce said output stream.